CLAIMS

1. A thermistor device comprising a mixed sintered body of $(M1M2)O_3 \cdot Al_2O_3$ consisting of $(M1M2)O_3$ and Al_2O_3, wherein M1 is at least one or more elements selected from the elements of Group 2A or Group 3A of the periodic table excluding La, and M2 is at least one or more elements selected from the elements of Group 2B, Group 3B, Group 4A, Group 5A, Group 6A, Group 7A or Group 8 of the periodic table.

2. The thermistor device according to claim 1 characterized in that, when taking the mole fraction of the aforementioned $(M1M2)O_3$ to be **a** and the mole fraction of the aforementioned Al_2O_3 to be **b**, these mole fractions **a** and **b** satisfy the relationships $0.05 \leq a < 1.0$, $0 < b \leq 0.95$ and $a + b = 1$.

3. The thermistor device according to claim 1 characterized in that, M1 is one or more elements selected from the group Y, Ce, Pr, Nd, Sm, Eu, Gd, Dy, Ho, Er, Yb, Mg, Ca, Sr, Ba and Sc, while M2 is one or more elements selected from the group Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Al, Ga, Zr, Nd, Mo, Hf, Ta and W.

4. The thermistor device according to claim 3 characterized in that said M1 is Y, said M2 is Cr and Mn and said $(M1M2)O_3$ is $Y(CrMn)O_3$.

5. The thermistor device according to claim 1 characterized in that it contains a sintering aid comprising SiO_2 and at least one member of the group CaO, $CaCO_3$ and $CaSiO_3$.

6. A temperature sensor characterized in that it contains the thermistor device according to claim 1.

7. A thermistor device comprising a mixed sintered body of $(M1M2)O_3 \cdot Al_2O_3 \cdot Y_2O_3$ consisting of $(M1M2)O_3$, Al_2O_3 and Y_2O_3, wherein M1 is at least one or more elements selected from the elements of Group 2A or Group 3A of the periodic table excluding La, and M2 is at least one or more elements selected from the elements of Group

2B, Group 3B, Group 4A, Group 5A, Group 6A, Group 7A or Group 8 of the periodic table.

8. The thermistor device according to claim 7 characterized in that, when taking the mole fraction of said $(M1M2)O_3$ to be **a** and the sum of the mole fraction of said Y_2O_3 and Al_2O_3 to be **b**, these mole fractions **a** and **b** satisfy the relationships $0.05 \leq a < 1.0$, $0 < b \leq 0.95$ and $a + b = 1$.

9. The thermistor device according to claim 7 characterized in that, M1 is one or more elements selected from the group Y, Ce, Pr, Nd, Sm, Eu, Gd, Dy, Ho, Er, Yb, Mg, Ca, Sr, Ba and Sc, while M2 is one or more elements selected from the group Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Al, Ga, Zr, Nd, Mo, Hf, Ta and W.

10. The thermistor device according to claim 9 characterized in that said M1 is Y, said M2 is Cr and Mn and said $(M1M2)O_3$ is $Y(CrMn)O_3$.

11. The thermistor device according to claim 7 characterized in that it contains a sintering aid comprising SiO_2 and at least one member of the group CaO, $CaCO_3$ and $CaSiO_3$.

12. A temperature sensor characterized in that it contains the thermistor device according to claim 7.

13. A method for manufacturing a thermistor device according to claim 1, comprising the steps of:

performing a calcining step to obtain said $(M1M2)O_3$, which has an average grain size greater than that of said Al_2O_3, and

mixing and grinding said $(M1M2)O_3$ and Al_2O_3 so that the average grain size of this mixture after grinding is no greater than the average grain size of said Al_2O_3 prior to mixing, and then performing the steps of molding into a prescribed shape and sintering.

14. A method for manufacturing a thermistor device according to claim 1, comprising the steps of:

mixing and grinding the material for said M1 together with the material for said M2 so that the

average grain size of this mixed ground product after grinding is no greater than the average grain size of the material for M1 prior to mixing and also no greater than 0.5 μm, and then performing a calcining step to obtain said $(M1M2)O_3$, and

mixing said $(M1M2)O_3$ obtained by said calcining step with said Al_2O_3, and then molding into a prescribed shape and sintering.

15. The method according to claim 14 comprising the steps of: mixing and grinding said $(M1M2)O_3$ obtained by said calcining step with said Al_2O_3 so that the average grain size of this mixture after grinding is no greater than the average grain size of said Al_2O_3 prior to mixing, and then performing the steps of molding into a prescribed shape and sintering.

16. A method for manufacturing a thermistor device according to claim 7, comprising the steps of:

performing a calcining step to obtain said $(M1M2)O_3$, which has an average grain size greater than that of said Al_2O_3,

mixing and grinding said $(M1M2)O_3$, Y_2O_3 and Al_2O_3 so that the average grain size of this mixture after grinding is no greater than the average grain size of said Y_2O_3 and Al_2O_3 prior to mixing, and then performing the steps of molding into a prescribed shape and sintering.

17. A method for manufacturing a thermistor device according to claim 7, comprising the steps of:

mixing and grinding the material for said M1 together with the material for said M2 so that the average grain size of this mixed ground product after grinding is no greater than the average grain size of the material for M1 prior to mixing and also no greater than 0.5 μm, and then performing a calcining step to obtain said $(M1M2)O_3$, and

mixing said $(M1M2)O_3$ obtained by said calcining step with said Y_2O_3 and Al_2O_3, and then molding into a prescribed shape and sintering.

18. The method according to claim 17 comprising the steps of: mixing and grinding said $(M1M2)O_3$ obtained by said calcining step with said Y_2O_3 and Al_2O_3 so that the average grain size of this mixture after grinding is no greater than the average grain size of said Y_2O_3 and Al_2O_3 prior to mixing, and then performing the steps of molding into a prescribed shape and sintering.

19. A method for manufacturing a thermistor device according to claim 7, comprising the steps of:

using a raw material for said M1 that contains at least Y_2O_3,

performing a calcining step to obtain $(M1M2)O_3 \cdot Y_2O_3$ which has an average grain size greater than that of said Al_2O_3,

mixing and grinding said $(M1M2)O_3 \cdot Y_2O_3$ and said Al_2O_3 or said Y_2O_3 and Al_2O_3 so that the average grain size of this mixture after grinding is no greater than the average grain size of said Y_2O_3 and Al_2O_3 prior to mixing, and then performing the steps of molding into a prescribed shape and sintering.

20. A method for manufacturing a thermistor device according to claim 7, comprising the steps of:

using a raw material for said M1 that contains at least Y_2O_3,

mixing and grinding the material for said M1 together with the material for said M2 so that the average grain size of this mixed ground product after grinding is no greater than the average grain size of the material for M1 prior to mixing and also no greater than 0.5 μm, and then performing a calcining step to obtain $(M1M2)O_3 \cdot Y_2O_3$, and

mixing this $(M1M2)O_3 \cdot Y_2O_3$ with said Al_2O_3 or said Y_2O_3 and Al_2O_3, and then molding into a prescribed shape and sintering.

21. The method according to claim 20 comprising the steps of: mixing and grinding said $(M1M2)O_3 Y_2O_3$ obtained by said calcining step with said Al_2O_3 or said Y_2O_3 and Al_2O_3 so that the average grain size of this mixture after grinding is no greater than the average grain size of said Y_2O_3 and Al_2O_3 prior to mixing, and then performing the steps of molding into a prescribed shape and sintering.

22. A method for manufacturing a thermistor device comprising a sintered body, comprising:

a step in which a plurality of precursor compounds that contain metallic elements are mixed in the liquid phase to form a liquid mixture,

a step in which a metallic salt precipitating agent is added to said liquid mixture to precipitate a gelatinous precipitate of metallic salts containing a plurality of said metallic elements,

a step in which said precipitate is subjected to drying and heat treatment to form powdered raw material which is a powder composition containing a plurality of said metallic elements, and

a step in which said powdered raw material is sintered to form said sintered body.

23. The method according to claim 22 wherein, in said step of forming a liquid mixture, said plurality of precursor compounds are mixed in the liquid phase together with a complexing compound that has at least two carboxyl groups as coordination sites and also has at least one other coordination site, to form said liquid mixture, and

said plurality of precursor compounds and said complexing compound are caused to react in said liquid mixture to form a composite metal complex compound

in which at least one of said metallic elements is coordinated.

24. The method according to claim 23 characterized in that ethylenediamenetetraacetic acid (EDTA) or citric acid is used as said complexing compound.

25. The method according to claim 22 characterized in that one or more organometallic compounds selected from the group of metal alkoxides, metal acetylacetonates or metal carboxylates are used as said precursor compounds.

26. The thermistor device manufacturing method according to claim 22 characterized in that one or more inorganic metal compounds selected from the group of nitrate compounds, oxynitrate compounds, chlorides and oxychloride compounds are used as said precursor compounds.

27. A method for manufacturing a thermistor device comprising a sintered body, comprising:

a step in which a plurality of precursor compounds that contain metallic elements are mixed in the liquid phase to form a liquid mixture,

a step in which powdered raw material which is a powder composition containing a plurality of said metallic elements is formed from said liquid mixture, and

a step in which said powdered raw material is sintered to form said sintered body.

28. A temperature sensor characterized in that it contains a thermistor device that is manufactured by one of the manufacturing methods according to claims 18-23 and in that the grain size of said sintered body is smaller than 1 μm.

29. A method for manufacturing a thermistor device comprising a sintered body of $(M1M2)O_3 \cdot Y_2O_3$ consisting of $(M1M2)O_3$ and Y_2O_3, wherein M1 is at least one or more elements selected from the elements of Group 2A or Group

3A of the periodic table excluding La, and M2 is at least one or more elements selected from the elements of Group 2B, Group 3B, Group 4A, Group 5A, Group 6A, Group 7A or Group 8 of the periodic table, comprising:

a step in which a plurality of precursor compounds that contain M1, M2 and Y constituting said thermistor device are mixed with a complex-forming agent in the liquid phase to form a liquid mixture,

a step in which said plurality of precursor compounds and said complex-forming agent are caused to react in the liquid phase to form a composite complex compound,

a step in which a polymerizing agent is added to said composite complex compound to form a polymer,

a step in which said polymer is subjected to drying and heat treatment to form powdered raw material containing the elements that constitute said thermistor device, and

a step in which said powdered raw material is sintered to form said sintered body of $(M1M2)O_3 \cdot Y_2O_3$.

30. The method according to claim 29 characterized in that citric acid is used as said complex-forming agent and ethylene glycol is used as said polymerizing agent, and moreover, if **e** is the number of moles of said citric acid and **f** is the total number of moles of M1, M2 and Y that constitute the thermistor device, then **e** and **f** satisfy the relationship $1 \le e/f \le 30$.

31. The method according to claim 29 characterized in that, when taking the mole fraction of said $(M1M2)O_3$ to be **c** and the mole fraction of said Al_2O_3 to be **d**, these mole fractions **c** and **d** satisfy the relationships $0.05 \le c < 1.0$, $0 < d \le 0.95$ and $c+d=1$.

32. The method according to claim 29 characterized in that, M1 is one or more elements selected from the group Y, Ce, Pr, Nd, Sm, Eu, Gd, Dy, Ho, Er, Yb, Mg, Ca,

Sr, Ba and Sc, while M2 is one or more elements selected from the group Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Al, Ga, Zr, Nd, Mo, Hf, Ta and W.

33. The method according to claim 32 characterized in that said M1 is Y, said M2 is Cr and Mn and said mixed sintered body is $Y(CrMn)O_3 \cdot Y_2O_3$.

34. A temperature sensor characterized in that it contains a thermistor device that is manufactured by the manufacturing methods according to claim 29.

35. A thermistor device comprising a thermistor portion (13) and an anti-reducing coating (14) consisting of an anti-reducing material formed on the surface of this thermistor portion (13).

36. The thermistor device according to claim 35 characterized in that said anti-reducing material is one that is formed by applying an organometallic compound as a precursor to the surface of this thermistor portion (13) and then performing a firing step.

37. The thermistor device according to claim 35 characterized in that said anti-reducing material comprises one or more elements selected from the group of Y, Al and Si.

38. The thermistor device according to claim 37 characterized in that said anti-reducing material is a material of one or more members selected from the group of Y_2O_3, Al_2O_3, SiO_2, $Y_3Al_5O_{12}$, $3Al_2O_3 \cdot 2SiO_2$ (mullite) and Y_2SiO_5.

39. The thermistor device according to claim 35 characterized in that it can be used at a temperature of 900°C or greater.

40. A method of manufacturing a thermistor device comprising a thermistor portion (13) made of thermistor material and an anti-reducing coating (14) consisting of an anti-reducing material formed on the surface of this thermistor portion (13), comprising the steps of:

applying a precursor to said anti-reducing material to the surface of this thermistor portion and then performing a firing step to form an anti-reducing coating (14) on the surface of this thermistor portion (13).

41. The method of manufacturing a thermistor device according to claim 37 characterized in that an organometallic compound is used as the precursor to said anti-reducing material.

42. The method of manufacturing a thermistor device according to claim 41 characterized in that a metal alkoxide of one or more elements selected from the group Y, Al and Si is used as said organometallic compound.

43. The method of manufacturing a thermistor device according to claim 41 characterized in that the precursor to said anti-reducing material is applied to the surface of said thermistor portion (13) by means of dip coating the surface of said thermistor portion (13) using a liquid that contains said organometallic compound used as the precursor to said anti-reducing material.

44. A temperature sensor comprising:

a thermistor portion (13) made of thermistor material and an anti-reducing coating (14) consisting of an anti-reducing material formed on the surface of this thermistor portion (13), and

a pair of electrically conducting members (11 and 12) that penetrate said anti-reducing coating (14) and make electrical contact with the thermistor portion (13);

characterized in that said anti-reducing material has an electrical resistance greater than that of said thermistor material and is an electrical insulator.